Patent Claims

1. A method for the optimization of identification of the current position in navigation, especially neuronavigation, in surgery with an operating microscope and at least one optoelectronic image receiver, which may also be connectable to a microscope, and a computer system,
characterized in that
the data obtained from the at least one image receiver, each of which lie in the microscope field-of-view of the operator, contain information about the location of the operating instrument, especially of the tip of this instrument, wherein the actual position of the instrument in the x- and y-direction as well as in the z-direction of a three-dimensional coordinate system is continuously or intermittently determined from the respective location data and wherein especially for the positional determination in the z-direction a distance determination is carried out by means of a depth of focus evaluation and/or or a stereoscopic image analysis and/or an evaluation of the signals obtained by a PMD sensor (Photonic Mixer Device) including the pertinent modulated illumination.

2. A method according to claim 1,
characterized in that
the optoelectronic image receiver(s) is/are directly coupled to the observation beam path, especially by means of beam splitters.

3. A method according to claim 1,
characterized in that
at least one separate image receiver beam path not depending on the observation beam path is provided, which is directed to the microscope field-of-view of the operator.

4. A method according to one of the preceding claims,
characterized in that

the location of the operating microscope in space is detected and said operating microscope positional data are supplied to the computer system so as to transform the positional data of the instrument into a higher ranking space coordinate system by including existing data on the current position of the patient and preoperatively obtained three-dimensional data from the interior of the patient.

5. A method according to one of the preceding claims, characterized in that beside the data acquisition for the intraoperative location and position determination of a navigational instrument by means of known optical and/or magnetic methods, a supplementary three-dimensional position detection is carried out by means of the data provided by the image receiver of the operating microscope.

6. A method according claim 5, characterized in that if valid data records exist in only one of said two systems, the data determined as being valid are used for determining the position and location of the instrument or for tracking the instrument.

7. A method according to claim 5, characterized in that if redundant data records defined as being valid exist, the same are used to increase the measuring exactness and/or to quantify the measuring exactness.

8. Method according to claim 4, characterized in that for the detection of the location of the operating microscope in space, a stereo camera pair is provided at or on the microscope, which allows a motion tracking relative to fixed markings provided to the patient and/or in space.

9. A method according to one of the preceding claims,
characterized in that
marking points are provided at or on the tissue surface of the patient, the change of location of which detected by the image receivers and determined by means of the computer system is used for determining the brain shifting at the open skull so as to perform a correction of preoperatively obtained data.

10. A method according to claim 1 and 2 or 4 to 9,
characterized in that
the operating microscope comprises two optical channels brought out of center behind a common front lens having a common object plane and the same magnification for both optical channels, wherein a correction function for the distortion errors is incorporated in the stereoscopic image analysis, which is dependent on the currently used settings of zoom and focus.

11. Method according to claim 10,
characterized in that
a calibration is performed for the correction of errors, wherein the parameters of the mentioned correction function are empirically determined by calibration measurements at different settings of zoom and focus and different object interspaces and the obtained parameter set is stored.

12. A navigational instrument with markings, especially for a method according to one of claims 1 to 11,
characterized in that
the markings are disposed in the proximity of the instrument tip, wherein the maximum distance to the instrument tip is selected such that the markings are located in the field of view of the microscope during use and the minimum distance to the instrument tip is substantially larger than 2 mm.

13. A navigational instrument according to claim 12,
characterized in that
the markings are formed as micromarking or microbody.

14. A navigational instrument according to claim 13,
characterized in that
the markings are formed as at least three microballs or elevations on the navigational instrument, which spread a triangle and reflect colored or infrared light.

15. A navigational instrument according to claim 13.
characterized in that
the markings are formed as ring-type shadings and/or colorings and or reflectors on the navigational instrument.

16. A navigational instrument according to claim 13.
characterized in that
several of said mentioned differently sized marking sets are provided on the instrument and the smaller ones of said marking sets, relative to the larger marking sets, are positioned closer to the tip of the instrument.

17. A navigational instrument according to one of claims 12 to 16,
characterized in that
in addition, further non-microscopic type markings detectable with navigational systems known per se are disposed on the side facing away from the instrument tip or the corpus of the instrument is designed for the detection with magnetic navigational systems.

18. An operating microscope, especially for the use in a method according to one of the preceding claims,
characterized in that
the microscope comprises a module for detecting the space coordinates relative to the operating room or to the patient.

19. An operating microscope according to claim 18,
characterized in that

the module includes a stereo camera pair with a computer for the stereoscopic image analysis being associated therewith, wherein the stereo camera pair is aligned to marking points on the patient or in space, so that the location and orientation of the microscope relative to the patient or to the space can be determined.

20. An operating microscope according to claim 18,
characterized in that
the module includes a PMD sensor array with a computer for the evaluation of sensor data being associated therewith, wherein the PMD sensor array, with the pertinent optic and modulated illumination, is aligned to marking points on the patient or in space, so that the location and orientation of the microscope relative to the patient or to the space can be determined.

21. An operating microscope according to claim 18,
characterized in that
the module comprises a magnetic navigational system or components of such a system, especially echo sensors.

22. An operating microscope according to claim 18,
characterized in that
the module comprises one or more transmitters of a time of flight distance measurement system based on sound, ultrasound or on electromagnetic radiation, which operates in the time or frequency domain.

23. An operating microscope according to claim 18 or 22,
characterized in that
the module comprises one or more receivers of a time of flight distance measurement system based on sound or ultrasound or on electromagnetic radiation, which operates in the time or frequency domain.

24. An operating microscope according to claim 18,
characterized in that

the module comprises gyroscopes or inclination sensors.

25. An operating microscope according to claim 18,
characterized in that
the module comprises arrangements or facilities for combining different measurement methods according to claims 19 to 24.

26. An operating microscope, especially for the use in a method according to one of the preceding claims,
characterized in that
the measured distance value of a PMD sensor from a predefined area of the image field of the microscope, e.g. the center of the image, is transmitted to the navigational system.

27. An operating microscope, especially for the use in a method according to one of the preceding claims,
characterized in that
the measured distance value of a PMD sensor from a predefined area of the image field of the microscope, e.g. the center of the image, is provided and used as correcting variable for the focusing unit of the microscope.

28. An operating microscope, especially for the use in a method according to one of claims 1 to 11,
characterized in that
a device for the projection of light markings is provided, wherein the areas of the field of operation marked with said light are subjected to a stereoscopic image analysis by means of two cameras connected to the microscope.

29. An operating microscope, especially for the use in a method according to one of claims 1 to 11,
characterized in that
it includes a device for the projection of light markings connected to the microscope and that the areas of the field of operation marked with said light

can be evaluated by means of a camera connected to the microscope and stereoscopic image analysis by using the principle of the inverse camera.

30. An operating microscope, especially for the use in a method according to one of claims 1 to 11,
characterized in that
the microscope comprises a PMD sensor module connected therewith, on which the image of the situs is represented, and that an associated modulated illumination device is provided.

31. An operating microscope according to one of claims 28 to 30,
characterized in that
the currently obtained topographic data are transmitted to a navigational system and are used by the same as starting data for the correction of a brain shift.

32. An operating microscope according to one of claims 28 to 31,
characterized in that
the measured distance value from a predefined area of the field of view of the microscope, e.g. the center of the image, is transmitted to a navigational system.

33. An operating microscope according to one of claims 28 to 32,
characterized in that
the measured distance value from a predefined area of the field of view of the microscope, e.g. the center of the image, is transmitted to the focusing unit of the microscope as correcting variable.

34. An operating microscope according to one of claims 28 to 33,
characterized in that
one or more supporting points of detected topograms are marked onto said points by the projection of visible light.

35. An operating microscope according to one of claims 28 to 34,
characterized in that
either the optical observation channels of the microscope are used for the cameras, the device for the projection of light markings and/or the PMD sensor, or additional optical channels are provided and used.